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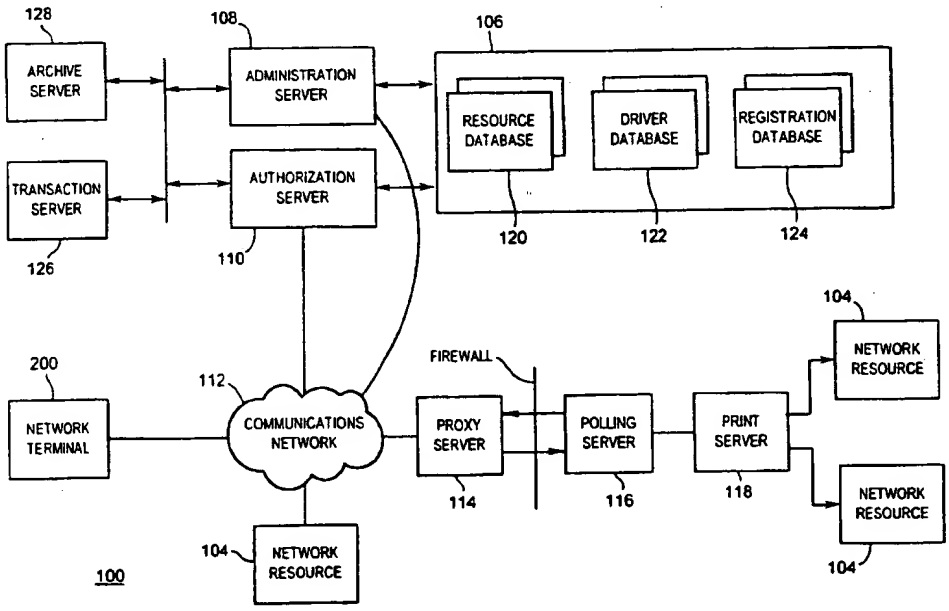
(54) Title: SECURE NETWORK RESOURCE ACCESS SYSTEM



(57) Abstract: A secure network resource access system facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server, to receive application data and associated network resource data from the proxy server in response to the poll, and to direct the application data to one of the network resources in accordance with the associated network resource data.

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SECURE NETWORK RESOURCE ACCESS SYSTEM

FIELD OF THE INVENTION

The present invention relates to a method and system for network management system. In particular, the present invention relates to a method and system for providing secure access to network resources.

BACKGROUND OF THE INVENTION

Local area networks are widely used as a mechanism for making available computer resources, such as file servers, scanners, and printers, to a multitude of computer users. It is often desirable with such networks to restrict user access to the computer resources in order to manage data traffic over the network and to prevent unauthorized use of the resources. Typically, resource access is restricted by defining access control lists for each network resource. However, as the control lists can only be defined by the network administrator, it is often difficult to manage data traffic at the resource level.

Wide area networks, such as the Internet, have evolved as a mechanism for providing distributed computer resources without regard to physical geography. Recently, the Internet Print Protocol ("IPP") has emerged as a mechanism to control access to printing resources over the Internet. However, IPP is replete with deficiencies.

First, as IPP-compliant printing devices are relatively rare, Internet printing is not readily available.

Second, although IPP allows user identification information to be transmitted to a target resource, access to IPP-compliant resources can only be changed on a per-resource basis. This limitation can be particularly troublesome if the administrator is required to change permissions for a large number of resources.

Third, users must have the correct resource driver and know the IPP address of the target resource before communicating with the resource. Therefore, if the device type or the IPP address of the target resource changes, users must update the resource driver and/or the IPP address of the resource. Also, if a user wishes to communicate

with a number of different resources, the user must install and update the resource driver and IPP address for each resource as the properties of each resource changes.

Fourth, access to IPP printers cannot be obtained without the resource administrator locating the resource outside the enterprise firewall, or without opening an access port through the enterprise firewall. Whereas the latter solution provides the resource administrator with the limited ability to restrict resource access, the necessity of opening an access port in the enterprise firewall exposes the enterprise network to the possibility of security breaches.

Consequently, there remains a need for a network resource access solution which allows resource owners to easily and quickly control resource access, which is not hindered by changes in device type and resource network address, which facilitates simultaneous communication with a number of target resources, and which does not expose the enterprise network to a significant possibility of security breaches.

SUMMARY OF THE INVENTION

According to the invention, there is provided a secure network resource access system and a method of secure network resource access which addresses at least one deficiency of the prior art network resource access systems.

The secure network resource access system, according to the present invention facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server.

The secure network resource access method, according to the present invention, facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises the steps of (1) polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources; (2) receiving application data and associated network resource

data from the proxy server in response to the polling step; and (3) directing the application data to one of the network resources in accordance with the associated network resource data.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the invention will now be described, by way of example only, with reference to the drawings, in which:

Fig. 1 is a schematic view of the network resource access system, according to the present invention, showing the network terminals, the network resources, the resource registry, the authorization server, the administration server, the proxy server, and the polling server;

Fig. 2 is a schematic view one of the network terminals depicted in Fig. 1, showing the driver application for use with the present invention;

Fig. 3 is a schematic view of the format of the resource records comprising the resource database of the resource registry depicted in Fig. 1, showing the network address field, the resource type field, the user access level field, the resource information field, the pseudo-name field, the username/password field, and the driver identification field; and

Fig. 4 is a flow chart depicting the method of operation of the network resource access system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to Fig. 1, a network resource access system, denoted generally as 100, is shown comprising a network terminal 200, a network resource 104, a resource registry 106, an administration server 108, and an authorization server 110. Typically, the network resource access system 100 comprises a plurality of network terminal 200, and a plurality of network resources 104, however for enhanced clarity of discussion, Fig. 1 only shows a single network terminal 200 and a single network resource 104.

The network resource access system 100 also includes a communications network 112 facilitating communication between the network terminals 200, the network resources 104, the administration server 108, and the authorization server 110. Preferably, the communications network 112 comprises a wide area network such as the Internet, however the network 112 may also comprise a local area network. Further, the network 112 need not be a land-based network, but instead may comprise a wireless network and/or a hybrid of a land-based network and a wireless network for enhanced communications flexibility.

Each network terminal 200 typically comprises a land-based network-enabled personal computer. However, the invention is not limited for use with personal computers. For instance, one or more of the network terminals 200 may comprise a wireless communications device, such as a wireless-enabled personal data assistant, or e-mail-enabled wireless telephone if the network 112 is configured to facilitate wireless data communication. In addition, the invention is not limited to only facilitating transmission of text data, but instead may be used to transmit image data, audio data or multimedia data, if desired.

As shown in Fig. 2, the network terminal 200 comprises a network interface 202, a user interface 204, and a data processing system 206 in communication with the network interface 202 and the user interface 204. Typically, the network interface 202 comprises an Ethernet network circuit card, however the network interface 202 may also comprise an RF antenna for wireless communication over the communications network 112. Preferably, the user interface 204 comprises a data entry device 208 (such as keyboard, microphone or writing tablet), and a display device 210 (such as a CRT or LCD display).

The data processing system 206 includes a central processing unit (CPU) 208, and a non-volatile memory storage device (DISC) 210 (such as a magnetic disc memory or electronic memory) and a read/write memory (RAM) 212 both in communication with the CPU 208. The DISC 210 includes data which, when loaded into the RAM 212, comprise processor instructions for the CPU 208 which define memory objects for allowing the network terminal 200 to communicate with the network resources 104 and the authorization server 110 over the communications network 112. The network

terminal 200, and the processor instructions for the CPU 208 will be discussed in greater detail below.

Typically, each network resource 104 comprises a printing device, and in particular, an IPP-compliant printer. However, the invention is not limited for use with networked printers (IPP-compliant or otherwise), but instead can be used to provide access to any of a variety of data communication devices, including facsimile machines, image servers and file servers. Further, the invention is not limited for use with land-based data communications devices, but instead can be used to provide access to wireless communications devices. For instance, the network resource access system 100 can be configured to facilitate data communication with e-mail pagers or e-mail enabled wireless telephones.

It is expected that some of the network resources 104 may be located behind an enterprise firewall. Accordingly, to facilitate communication between network terminals 200 and firewall-protected network resources 104, the network resource access system 100 may also include a proxy server 114 located logically outside the enterprise firewall, and a polling server 116 located logically within the firewall, as shown in Fig. 1. Preferably, the proxy server 114 is located on-site at the enterprise responsible for administering the network resource 104, is provided with a network address corresponding to the enterprise, and includes a queue for receiving application data. However, the proxy server 114 may also be located off-site, and may be integrated with the authorization server 110 if desired. This latter option is advantageous since it allows system administrators to provide access to network resources 104, but without having to incur the expense of the domain name registration and server infrastructure.

In addition to the proxy server 114 and the polling server 116, preferably the enterprise includes an enterprise server 118 (eg. a print server) to facilitate communication with the network resources 104 located behind the firewall. The polling server 116 is in communication with the enterprise server 118, and is configured to periodically poll the proxy server 114 through the firewall to determine whether application data from a network terminal 200 is waiting in the queue of the proxy server 114. The proxy server 114 is configured to transmit any queued

application data to the polling server 116 in response to the poll signal from the polling server 116. Upon receipt of the queued application data from the proxy server 114, the polling server 116 transmits the application to the enterprise server 118 for distribution to the appropriate network resource 104. As will be apparent, this mechanism allows application data to be transmitted to network resources 104 located behind a firewall, but without exposing the enterprise to the significant possibility of security breaches associated with firewall access ports.

The resource registry 106 comprises a resource database 120, a driver database 122, and a user registration database 124. The resource database 120 includes resource records 300 identifying parameters associated with the network resources 104. As shown in Fig. 3, each resource record 300 comprises a network address field 302, a resource type field 304, and a user access level field 306 for the associated network resource 104. The network address field 302 identifies the network address of the network resource 104. As discussed above, typically each network resource 104 comprises an IPP-compliant printer, in which case the network address field 302 identifies comprises the network resource IPP address. However, in the case where the network resource 104 comprises a non-IPP-compliant device and the communications network 112 comprises the Internet, preferably the network resource 104 is linked to the communications network 112 via a suitable server, and the network address field 302 for the network resource 104 identifies the Internet Protocol ("IP") address of the server.

The resource type field 304 identifies the type of data communication device of the network resource 104. For instance, the resource type field 304 may specify that the network resource 104 is a printer, an image server, a file server, an e-mail pager, or an e-mail enabled wireless telephone. Further, the resource type field 304 may include a resource type sub-field specifying a sub-class of the network resource type. For example, the resource type sub-field may specify that the network resource 104 is an IPP-capable printer, or a non-IPP-capable printer.

The user access level field 306 identifies the type of communications access which the network terminals 200 are allowed to have in regards to the associated network

resource 104. In the embodiment, as presently envisaged, the user access level field 306 establishes that the network resource 104 allows one of:

(a) "public access" in which any network terminal 200 of the network resource access system 100 can communicate with the network resource 104;

(b) "private access" in which only members (eg. employees) of the enterprise associated with the network resource 104 can communicate with the network resource 104; and

(c) "authorized access" in which only particular network terminals 200 can communicate with the network resource 104.

If the user access level field 306 specifies "authorized access" for a network resource 104, preferably the user access level field 306 includes a sub-field which lists the names of the network terminals 200 authorized to access the network resource 104, and a sub-field which includes an authorization password which the identified network terminals 200 must provide in order to access the network resource 104. If the user access level field 306 specifies "private access" for a network resource 104, preferably the user access level field 306 includes a sub-field which lists the network address of the network terminals 200 which are deemed to members of the enterprise.

It should be understood, however, that the user access level field 306 is not limited to identifying only the foregoing predefined user access levels, but may instead identify more than one of the predefined user access levels, or other user access levels altogether. For instance, the user access level field 306 may identify that the associated network resource 104 allows both private access to all employees of the enterprise running the network resource 104, and authorized access to other pre-identified network terminals 200. Further, the user access level field 306 may also include one or more sub-fields (not shown) which provide additional restrictions/permissions on the type of communications access which the network terminals 200 are allowed to have in regards to the associated network resource 104. For instance, the user access level sub-fields may limit the hours of operation of the network resource 104, or may place restrictions on the type of access limitations on a per-user basis, or per-group basis. Other variations on the type of access will be

readily apparent, and are intended to be encompassed by the scope of the present invention.

Preferably, each resource record 300 includes an information field 308 which provides information on the network resource 104, such as data handling capabilities, resource pricing and geographical co-ordinates. This latter parameter is particularly advantageous for use with mobile network terminals 200, such as a wireless-enabled personal data assistant or an e-mail-enabled wireless telephone, since it allows the network terminal 200 to identify the nearest one of a plurality of available network resources 104. This aspect of the invention will be explained in greater detail below.

Each resource record 300 also includes a pseudo-name field 310, a username/password field 312 and a network driver identifier field 314. The pseudo-name field 310 contains a resource pseudo-name which identifies the network resource 104 to the network terminals 200. Preferably, the pseudo-name is a network alias that identifies the physical location and properties of the network resource 104, but does not identify the network address of the resource 104. Further, preferably each pseudo-name uniquely identifies one of the network resources 104, however a group of the network resources 104 may be defined with a common pseudo-name to allow communication with a group of network resources 104. This latter feature is particularly advantageous since it allows the administrator of an enterprise associated with the group of network resources to dynamically allocate each network resource 104 of the group as the demands for the network resources 104 or maintenance schedules require.

In addition, preferably the resource record 300 includes a plurality of the pseudo-name fields 310 to allow the administrator of the associated network resource 104 to update the name assigned to the network resource 104, while also retaining one or more previous pseudo-names assigned to the network resource 104. As will be explained, this feature is advantageous since it allows the administrator to update a resource name without the risk that network terminals 200 using a prior pseudo-name will be unable to locate or communicate with the network resource 104.

The username/password field 312 contains a unique username and password combination which allows the administrator of the associated network resource 104 to prevent authorized access and alteration to the data contained in the resource record 300. Preferably, each resource record 300 also includes an e-mail address field (not shown) which the network resource access system 100 uses to provide the administrator of the associated network resource 104 with a notification e-mail message when a message is successfully transmitted to the network resource 104.

The driver identifier field 314 contains a resource driver identifier which is used in conjunction with the driver database 122 to provide the network terminals 200 with the appropriate resource driver for communication with the network resource 104. The driver database 122 includes resource drivers which allow software applications installed on the network terminals 200 to communicate with the network resources 104. As will be explained below, in order for a network terminal 200 to communicate with a selected network resource 104, the network terminal 200 first downloads a driver application data from the administration server 108 over the communications network 112. The network terminal 200 may also download the appropriate resource driver from the driver database 122 (via the authorization server 110 over the communications network 112), and then allow the authorization server 110 to configure the downloaded resource driver in accordance with the access level field 306 of the resource record 300 associated with the selected network resource 104. Preferably, each resource driver includes a resource driver identifier which allows the authorization server 110 to identify the resource driver which the network terminal 200 has downloaded.

The driver application will now be discussed in association with Fig. 2. As discussed above, the DISC 210 of the network terminal 200 includes data which, when loaded into the RAM 212 of the network terminal 200, comprise processor instructions for the CPU 208. As shown, the downloaded driver application data defines in the RAM 212 a memory object comprising a driver application 400. The driver application 400 includes a generic resource driver 402 and a wrap-around resource driver layer 404. The generic resource driver 402 allows the network terminal 200 to communicate with a variety of different network resources 104, however the generic resource driver 402 typically will not provide the network terminal 200 with access to all the features and

capabilities of any particular network resource 104. If the network terminal 200 requires additional features not implemented with the generic resource driver 402, the appropriate resource driver may be downloaded from the driver database 116, as mentioned above.

The wrap-around driver layer 404 includes an application communication layer 406, a driver administrator layer 408, and a data transmitter layer 410. The application communication layer 406 is in communication with the resource driver 402 (generic or network resource specific) and the application software installed on the network terminal 200, and is configured to transmit user application data between the application software and the resource driver 402. The driver administrator layer 408 communicates with the resource registry 106 over the communications network 112 to ensure that the driver application 400 is properly configured for communication with the selected network resource 104. The data transmitter layer 410 is in communication with the resource driver 402 and is configured to transmit the data output from the resource driver 402 over the communications network 112 to the selected network resource 104, via the network interface 202. Although the driver application 400 and its constituent component layers are preferably implemented as memory objects or a memory module in the RAM 212, it will be apparent that the driver application 400 may instead be implemented in electronic hardware, if desired.

Returning to Fig. 1, the registration database 124 of the resource registry 106 includes user records each uniquely associated with a user of a respective network terminal 200 upon registration with the network resource access system 100. Each user record identifies the name the registered user's name, post office address and e-mail address. In addition, each user record specifies a unique password which the registered user must specify in order to update the user's user record, and to obtain access to network resources 104 configured for "authorized access". The user record may also include additional information specifying default options for the network resource access system 100. For instance, the user may specify that the network resource access system 100 should provide the user with an acknowledgement e-mail message when a message is successfully transmitted to a selected network resource 104. The user may also specify an archive period for which the network resource access system 100 should archive the message transmitted to the selected network resource 104. This

latter option is advantageous since it allows the user to easily transmit the same message to multiple network resources 104 at different times, and to periodically review transmission dates and times for each archive message.

The administration server 108 is in communication with the resource database 120 and the registration database 124. The administration server 108 provides administrators of the network resources 104 with access to the records of the resource database 120 to allow the administrators to update the network address field 302, the resource type field 304, the user access level field 306, the resource information field 308, the pseudo-name field 310, the username/password field 312 and/or the driver identifier field 314 of the resource record 300 for the associated network resource 104. As will become apparent, this mechanism allows network administrators to change, for example, the network address and/or the restrictions/permissions of the network resources 104 under their control, or even the network resource 104 itself, without having to notify each network terminal 200 of the change. The administration server 108 also provides controlled access to the registration database 124 so that only the user of the network terminal 200 which established the user record can update the user record.

Where the username/password field 312 has been completed, the administration server 108 is configured to block access to the resource record 300 until the administrator provides the administration server 108 with the correct username/password key. This feature allows the resource administrator to make adjustments, for example, to pricing and page limit, in response to demand for the network resources 104, and to make adjustments to the restrictions/permissions set out in the user access level field 306 and the resource information field 308 and thereby thwart unauthorized access to the network resources 104.

The authorization server 110 is in communication with the resource database 120 and the driver database 122 for providing the network terminals 200 with the resource drivers 402 appropriate for the selected network resources 104. Preferably, the authorization server 110 is also configured to configure the driver application 400 for communication with the selected network resource 104, by transmitting the network address of the selected network resource 110 to the data transmitter layer 410 over a

communications channel secure from the user of the network terminal 200 so that the network address of the network resource 104 is concealed from the user of the network terminal 200. In the case where the communications network 112 comprises the Internet, preferably the secure communications channel is established using the Secure Sockets Layer ("SSL") protocol.

In addition to the network terminal 200, the network resource 104, the resource registry 106, the administration server 108, the authorization server 110, and the communications network 112, preferably the network resource access system 100 also includes a transaction server 126 and an archive server 128. The transaction server 126 is in communication with the authorization server 110 for keeping track of each data transfer between a network terminal 200 and a network resource 104. For each transmission, preferably the transaction server 126 maintains a transmission record identifying the network terminal 200 which originated the transmission, the network resource 104 which received the transmission, and the date, time and byte size of the transmission.

The archive server 128 is configured to retain copies of the data transmitted, for a specified period. As discussed above, the user of a network terminal 200 specifies the requisite archive period (if any) for the data transmission, upon registration with the network resource access system 100. Preferably, the administration server 108 provides controlled access to the transaction server 126 and the archive server 128 so that only the user of the network terminal 200 which originated transmission of the data is allowed access to the transmission record associated with the transmission.

The process by which a user of a network terminal 200 can communicate with a network resource 104 will now described with reference to Fig. 4. The following discussion presupposes that the user of the network terminal 200 has downloaded the driver application 400 from the administration server 108 over the communications network 112. At step 500, the user of a network terminal 200 decides whether to log in to the network resource access system 100. As discussed above, if the user registers with the network resource access system 100 and subsequently logs in to the network resource access system 100 (by providing the authorization server 106 with the user's assigned password), the user will have access to any network resources 104

which have "authorized access" as the user access level and which have identified the registered user as a user authorized to access the network resource 104. If the user does not register or fails to log in to the network resource access system 100, the user will only have access to network resources 104 which have established "public access" as the user access level.

At step 502, the user selects a network resource 104 by querying the administration server 108 for a list of available network resources 104. Alternately, the user may postpone selection of a network resource 104 until initiation of the transmission command. The network user query may be based upon any desired criteria, including print turn-around time and page size (where the target network resource 104 is a printer), price, and geography. In addition, the user may provide the administration server 108 with the geographical coordinates of the user to determine the user's nearest network resources. The user may provide its geographical coordinates through any suitable mechanism known to those skilled in the art, including latitude/longitude co-ordinates, GPS, and wireless triangulation.

If the user requested a list of available network resources 104, the user is provided with a list of pseudo-names associated with each network resource 104 satisfying the designated search criteria. As discussed above, if the user logged in to the network resource access system 100, the pseudo-name list will include both "public access" network resources 104 and "authorized access" network resources 104 with which the user has been authorized to communicate. Also, if the user is member of an enterprise having network resources 104 registered with the network resource access system 100, the pseudo-name list will also identify network resources 104 which have been registered by the enterprise for "private access". Otherwise, the pseudo-name list will only identify network resources 104 registered for public access. Upon receipt of the resource list, the user selects a network resource 104 from the list.

At step 504, the administration server 108 queries the network user's network terminal 200 for the resource driver identifier of the resource driver 402 configured on the network terminal 200, and then compares the retrieved resource driver identifier against the resource driver identifier specified in the network driver identifier field 314 of the resource record 300 associated with the selected network resource 104 to

determine whether the driver application 400 has been configured with the appropriate resource driver 402 for communication with the network resource 104. If the network terminal 200 has not been configured with the appropriate resource driver 402, the administration server 108 prompts the user's network terminal 200 to download the necessary resource driver 402. As will be apparent, the downloaded resource driver 402 becomes part of the driver application 400.

When the user of the network terminal 200 is ready to communicate with the selected network resource 104, the user of the network terminal 200 transmits a transmission request via its application software to the driver application 400, at step 506. If the user did not select a network resource 104 at step 502, the application communication layer 406 of the driver application 400 contacts the administration server 108 over the communications network 112 and prompts the user to select a network resource 104, as described above. Once a network resource 104 is selected, and the appropriate resource driver 402 is installed, the application communication layer 406 notifies the driver administrator layer 408 of the transmission request.

At step 508, the driver administrator layer 408 provides the authorization server 110 with the transmission request and identifies the selected network resource 104, by transmitting to the authorization server 110 the pseudo-name assigned to the selected network resource 104. If the user of the network terminal 200 has registered and logged in to the network resource access system 100, the driver administrator layer 408 also provides the authorization server 110 with the registered user's name.

The authorization server 110 then queries the resource database 120 with the received pseudo-name for the resource record 300 associated with the pseudo-name, at step 510. The authorization server 110 then extracts the user access level from the user access level field 306 of the retrieved resource record 300, and determines whether the network terminal 200 is authorized to communicate with the selected network resource104, at step 512. As will be apparent from the foregoing discussion, if the user access level field 306 specifies "public access" for the network resource 104, the network terminal 200 will be automatically authorized to communicate with the network resource 104.

However, if the user access level field 306 specifies "private access" for the network resource 104, the authorization server 110 determines the network address of the network terminal 200 from the transmission request transmitted by the network terminal 200, and then queries the user access level sub-field with the terminal's network address to determine whether the network terminal 200 is authorized to communicate with the network resource104. In the case where the communications network 112 comprises the Internet, the authorization server 110 can determine the network terminal's network address from the IP packets received from the network terminal 200. On the other hand, if the user access level field 306 specifies "authorized access" for the network resource 104, the authorization server 110 queries the user access level sub-field with the user's name to determine whether the network terminal 200 is authorized to communicate with the network resource104.

If the query at step 512 reveals that the network terminal 200 is not authorized to communicate with the network resource104, at step 514 the authorization server 110 provides the network terminal 200 with a notification that the network terminal 200 is not authorized for communication with the selected resource 104. However, if the query at step 512 reveals that the network terminal 200 is authorized to communicate with the network resource 104, the authorization server 110 queries the network address field 302 of the resource record 300 associated with the network resource 104 for the network address of the network resource 104. The authorization server 110 then establishes a secure communications channel with the driver administrator layer 408, and then transmits the network address to the driver administrator layer 408 over the secure communications channel, at step 516.

Also, if the user access level field 306 specifies "authorized access" for the network resource 104, and the network terminal 200 is authorized to communicate with the network resource104, the authorization server 110 queries the user access level sub-field for the authorization password assigned to the network resource 104, and then transmits the authorization password to the driver administrator layer 408 over the secure communications channel, together with the network address. In the case where the communications network 112 comprises the Internet, preferably the authorization server 110 establishes the secure communications channel using a Secure Sockets Layer ("SSL") protocol. Since the network address and the authorization password

are transmitted over a secure communications channel, this information is concealed from the user of the network terminal 200.

Preferably, the authorization server 110 also extracts the resource driver identifier from the resource identifier field 314 of the resource record 300, and determines whether the network terminal 200 is still properly configured for communication with the network resource 14. If the network terminal 200 no longer has the correct resource driver 402, the authorization server 110 queries the driver database 122 for the correct resource driver 402, and prompts the user of the network terminal 200 to download the correct resource driver 402. This driver configuration verification step may be performed concurrently or consecutively with the network address providing step described in the preceding paragraph.

In addition, the administration server 108 queries the registration database 124 to determine whether the user of the network terminal 200 registered with the network resource access system 100. If the user registered with the network resource access system 100 and specified that the archive server 128 should maintain archival copies of data transmissions, the administration server 108 transmits the network address of the archive server 128 to the driver administrator layer 408. As a result, when the user of the network terminal 200 issues a data transmission command, the driver application 400 will transmit the user application data to the selected network resource 104 and to the archive server 128.

At step 518, the application communication layer 406 passes the application data received from the application software to the resource driver 402 for translation into a format suitable for processing by the selected network resource 104. Meanwhile, the driver administrator layer 408 interrogates the network resource 104, using the received network address, to determine whether the network resource 104 still resides at the specified network address, is operational and is on-line.

If the interrogated network resource 104 resides at the specified network address, is operational and is on-line. online, the resource driver 202 passes the translated application data to the data transmitter layer 410 of the driver application 400. Preferably, the data transmitter layer 410 compresses and encrypts the translated

application data upon receipt. The data transmitter layer 410 also receives the network address of the network resource 104 from the driver administrator layer 408, adds the network address data to the compressed, encrypted data, and then transmits the resulting data over the communications network 112 to the network resource 104 at the specified network address, at step 520.

Preferably, the data transmitter layer 410 also transmits details of the transmission to the transaction server 126, such as the selected network resource 104 and the byte size of the transmission. Upon receipt of the transmission details, preferably the administration server 108 queries the resource database 120 and the user registration database 124 for the e-mail address of the resource administrator and the e-mail address of the user of the network terminal 200, if provided, and then transmits an e-mail message indicating completion of the transmission.

If the user access level field 306 specifies "authorized access" for the network resource 104, the data transmitter layer 410 also receives the authorization password for the network resource 104 from the driver administrator layer 408, and transmits the authorization password (as part of the compressed, encrypted data) to the network resource 104.

If the user access level field 306 specifies "public access" for the network resource 104, preferably the network resource 104 is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data, and then transmit the decompressed application data to the appropriate network resource 104. Alternately, the network resource 104 itself may be configured for direct communication over the communications network 112, such as an IPP-capable printer, so that the network resource 104 is able to process the application data directly.

If the user access level field 306 specifies "authorized access" for the network resource 104, preferably the network resource 104 is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data and authorization password, and then transmit the application

data to the appropriate network resource 104 if the received authorization password is valid.

If the user access level field 306 specifies "private access" for the network resource 104, typically the network resource 104 will be located behind a firewall. Accordingly, the proxy server 114 associated with the network resource 104 will receive the application data, and transfer the application data to the proxy server queue. The polling server 116 associated with the network resource 104 will poll the proxy server 114 to determine the status of the queue. Upon receipt of a polling signal from the polling server 116, the proxy server 114 transmits any queued application data from the proxy server queue, through the firewall, to the polling server 116. The polling server 116 then extracts the network address from the received application data, and transmits the application data to the appropriate server 118 or network resource 104 for processing.

As will be apparent from the foregoing discussion, regardless of the user class defined for a network resource 104, if a resource administrator relocates a network resource 104 to another network address, and/or changes the device type and/or restrictions/permissions associated with the network resource 104, the resource administrator need only update the resource record 300 associated with the network resource 104 to continue communication with the network resource 104. Subsequently, when a user attempts communication with the network resource 104 using the original pseudo-name, the authorization server 110 will provide the administrator layer 408 with the updated network address of the network resource 104, or prompt the user to download the appropriate resource driver 402, assuming that the network terminal 200 is still authorized to communicate with the network resource 104.

Further, if the user access level field 306 specifies "authorized access" for the network resource 104 and the resource administrator desires to change the pseudo-name and authorization password associated with the network resource 104, the resource administrator need only update the pseudo-name and authorization password provided on the resource record 300. Subsequently, when a user of a network terminal 200 initiates communication with the network resource 104 using the original pseudo-

name, the authorization server 110 scans the resource records 300 for occurrences of the original pseudo-name. After locating the appropriate resource record 300, the authorization server 110 provides the driver administrator layer 408 with the updated pseudo-name and authorization password of the network resource 104, provided that the network terminal 200 is still authorized to communicate with the network resource 104. A network terminal 200 which is not authorized to communicate with the network resource 104 will not receive the updated pseudo-name and authorization password from the authorization server 110 and, consequently, will not be able to communicate with the network resource 104, even if the user of the network terminal 200 knew the network address for the network resource 104.

The foregoing description is intended to be illustrative of the preferred embodiment of the present invention. Those of ordinary skill may envisage certain additions, deletions and/or modifications to the described embodiment which, although not explicitly described herein, are encompassed by the spirit or scope of the invention, as defined by the claims appended hereto.

WE CLAIM:

1. A secure network resource access system for facilitating network access by network terminals to network resources located behind an enterprise firewall, the secure network resource access system comprising:

a proxy server located logically outside the enterprise firewall for receiving application data from the network terminals; and

a polling server located logically behind the enterprise firewall, the polling server being configured for polling the proxy server to initiate transmission of the received application data from the proxy server to the polling server.

2. The secure network resource access system according to claim 1, wherein each said network resource includes an alias name, and the application data includes the alias name of one of the network resources, and the polling server is configured to direct the application data to the one network resource in accordance with alias name.

3. A method for facilitating secure network access by network terminals to network resources located behind an enterprise firewall, the method comprising the steps of:

polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources;

receiving application data and associated network resource data from the proxy server in response to the polling step; and

directing the application data to one of the network resources in accordance with the associated network resource data.

4. The method according to claim 3, wherein each said network resource includes an alias name, and the network resource data includes the alias name of the one network resource.

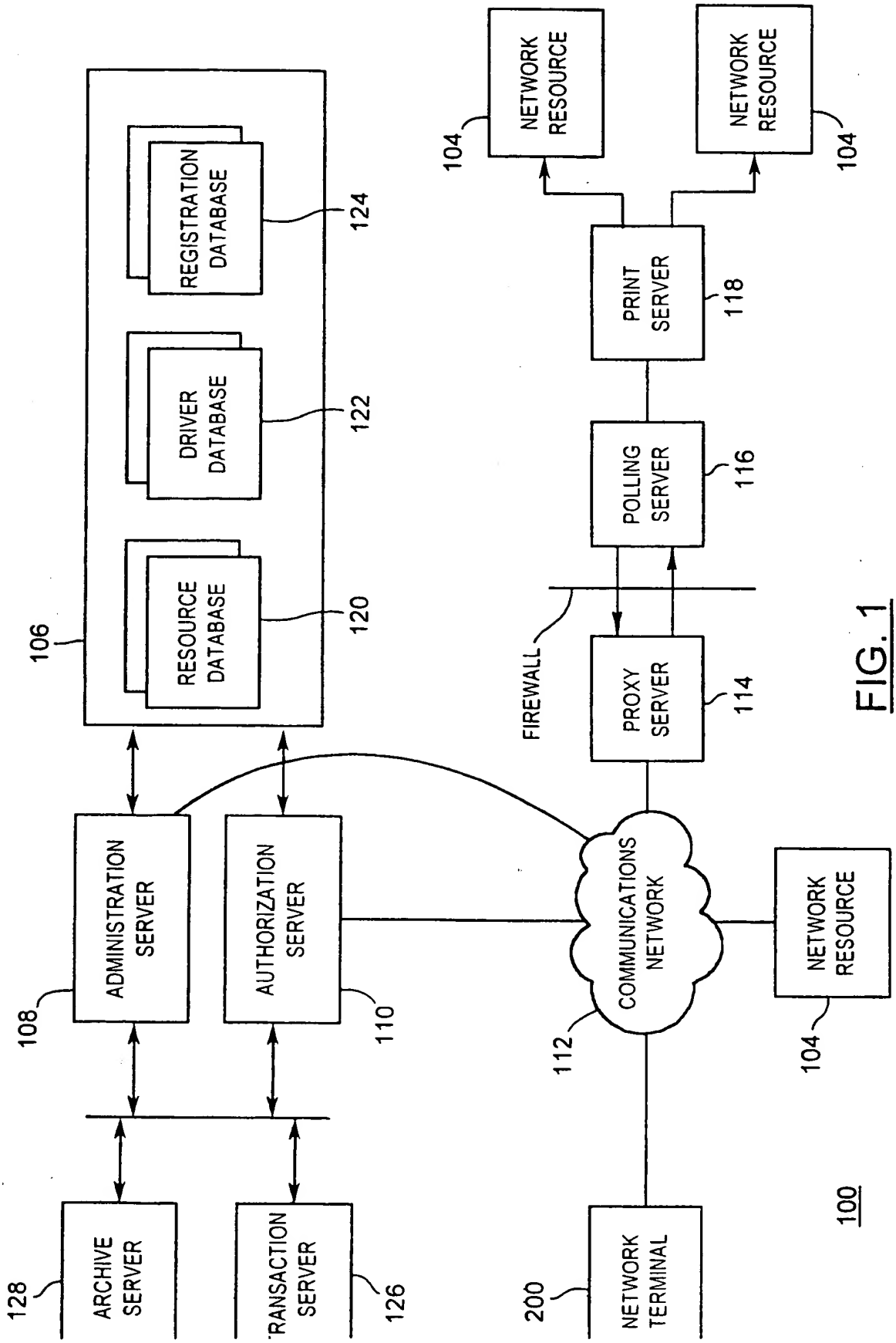
NETWORK RESOURCE
104
NETWORK RESOURCE
104
PRINT SERVER
118
POLLING SERVER
116
FIREWALL
PROXY SERVER
114
REGISTRATION DATABASE
124
DRIVER DATABASE
122
RESOURCE DATABASE
120
106
ADMINISTRATION SERVER
108
AUTHORIZATION SERVER
110
COMMUNICATIONS NETWORK
112
NETWORK RESOURCE
104
ARCHIVE SERVER
128
TRANSACTION SERVER
126
NETWORK TERMINAL
200
100

FIG. 1

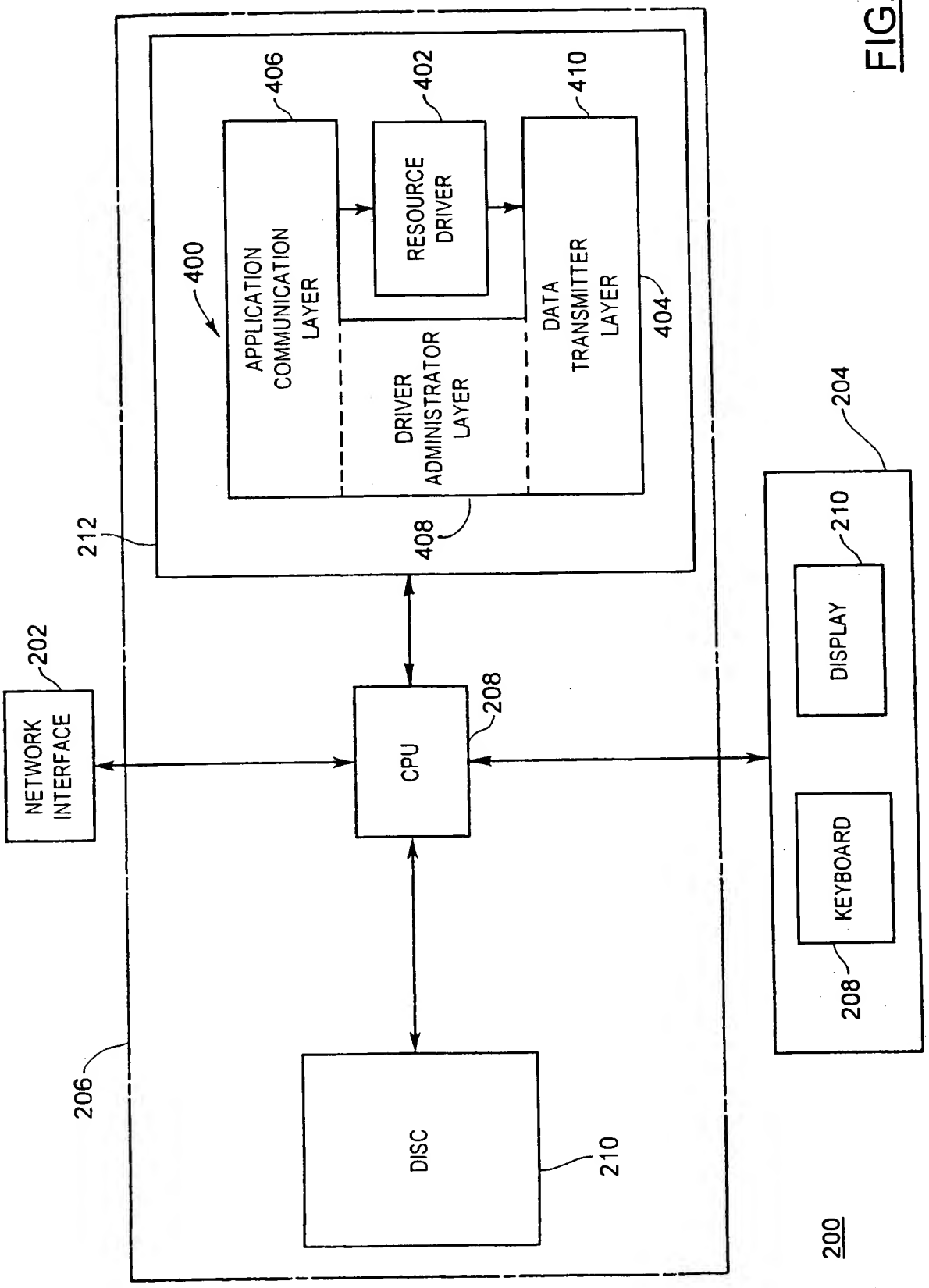
400
406
402
410
APPLICATION COMMUNICATION LAYER
RESOURCE DRIVER
DATA TRANSMITTER LAYER
404
DRIVER ADMINISTRATOR LAYER
408
212
202
NETWORK INTERFACE
CPU
208
204
210
DISPLAY
KEYBOARD
208
206
DISC
210
200

FIG. 2

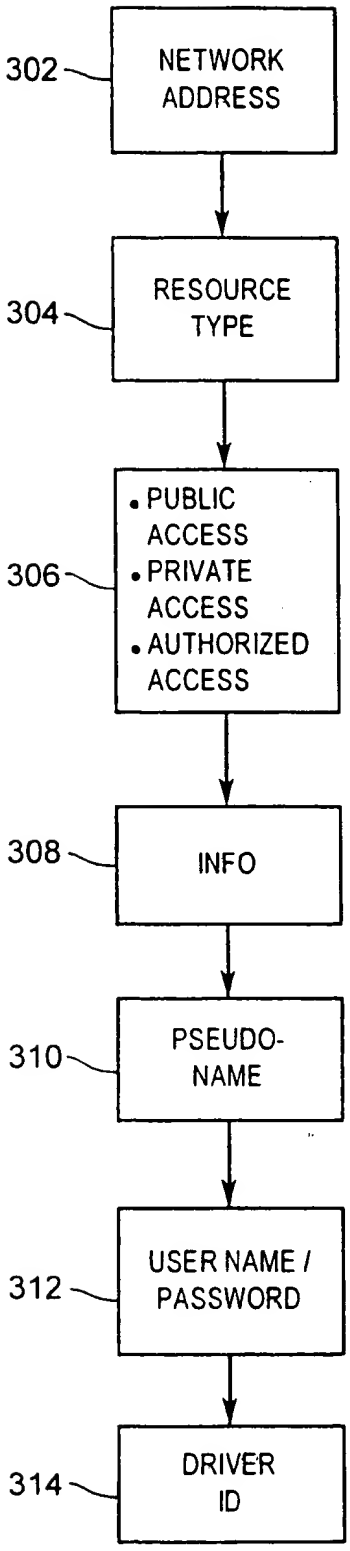
302
NETWORK ADDRESS
304
RESOURCE TYPE
306
• PUBLIC ACCESS
• PRIVATE ACCESS
• AUTHORIZED ACCESS
308
INFO
310
PSEUDO-NAME
312
USER NAME / PASSWORD
314
DRIVER ID
300

FIG. 3

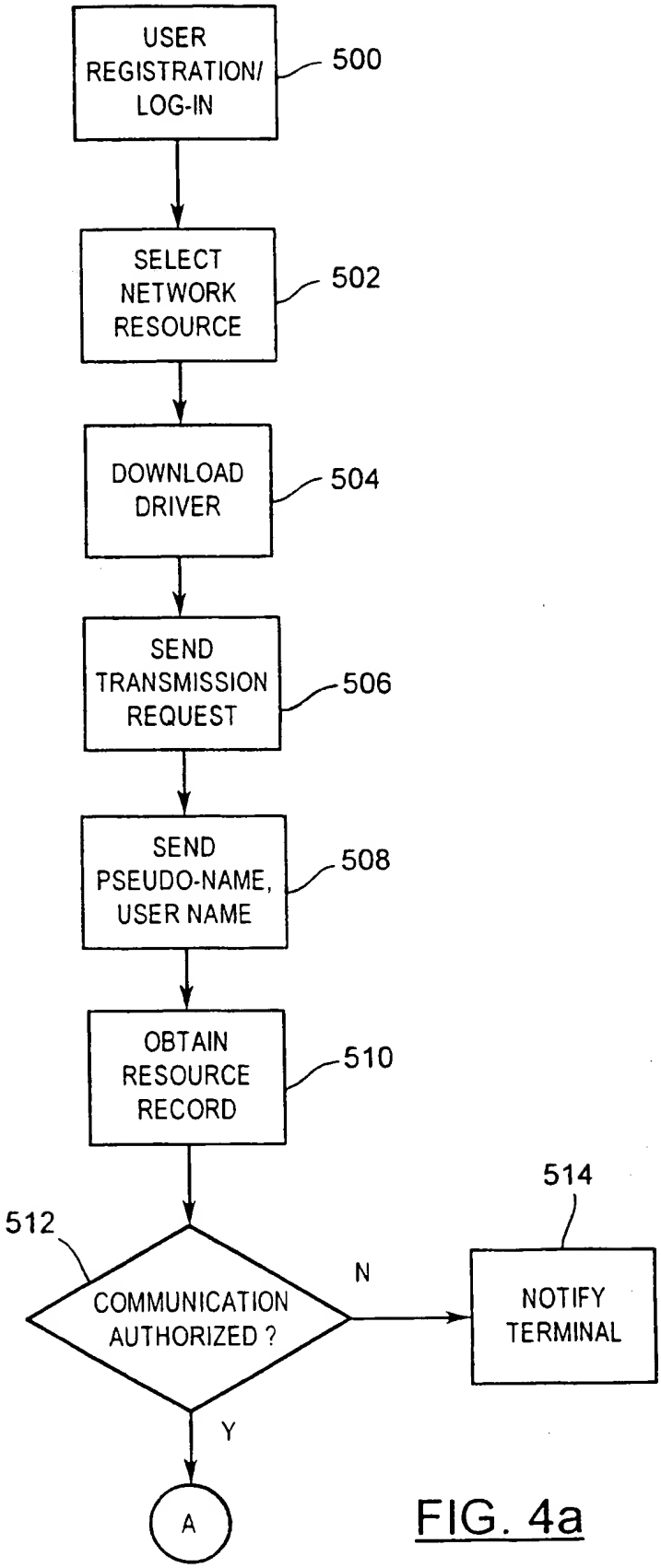
USER REGISTRATION/ LOG-IN
500
SELECT NETWORK RESOURCE
502
DOWNLOAD DRIVER
504
SEND TRANSMISSION REQUEST
506
SEND PSEUDO-NAME, USER NAME
508
OBTAIN RESOURCE RECORD
510
512
COMMUNICATION AUTHORIZED ?
N
514
NOTIFY TERMINAL
Y
A

FIG. 4a

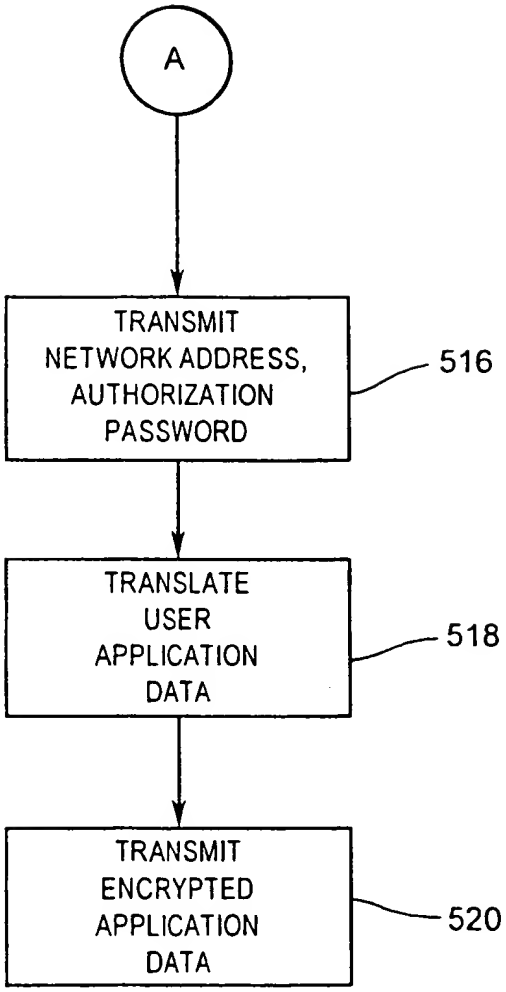
A
TRANSMIT NETWORK ADDRESS, AUTHORIZATION PASSWORD
516
TRANSLATE USER APPLICATION DATA
518
TRANSMIT ENCRYPTED APPLICATION DATA
520

FIG. 4b

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(21) International Application Number: PCT/CA01/00235

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(71) Applicant *(for all designated States except US)*: **SPICER CORPORATION** [CA/CA]; 221 McIntyre Drive, Kitchener, Ontario N2R 1G1 (CA).

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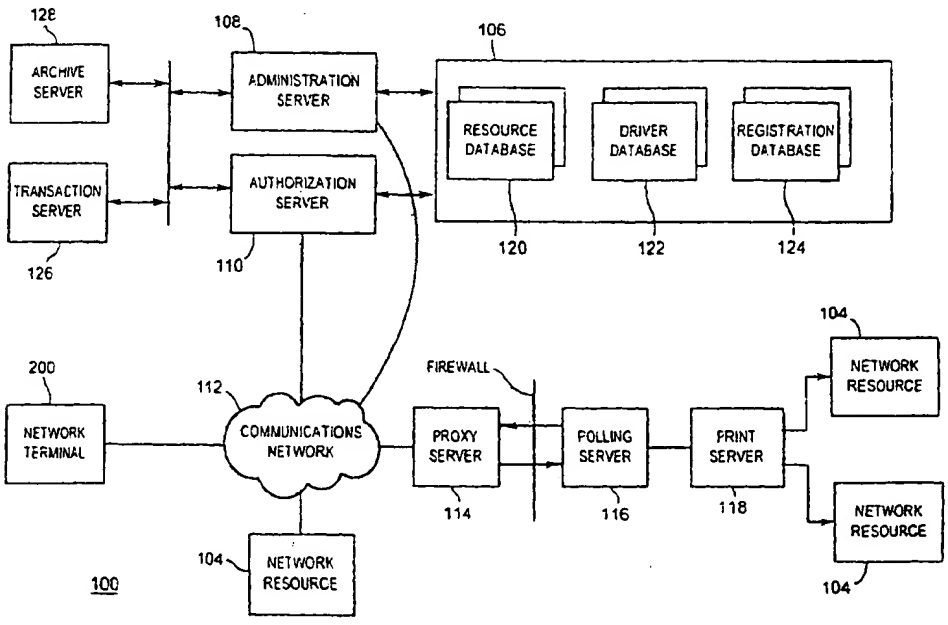
(75) Inventors/Applicants *(for US only)*: **SPICER, Steven** [CA/CA]; 119 Champlaine Crescent, Kitchener, Ontario N2B 2Y7 (CA). **MARTIN, Christopher** [CA/CA]; 66 Mooregate Crescent, Apt. 1304, Kitchener, Ontario N2M 5E6 (CA). **COUTTS, Steven** [CA/CA]; 99 John Street, Waterloo, Ontario N2L 1C2 (CA). **KUHL, Larry** [CA/CA]; 686 Jacob Lane, Waterloo, Ontario N2V 1G9 (CA). **HOLLANDER, Brian** [CA/CA]; 99 Julia Crescent, Kitchener, Ontario N2E 3M7 (CA). **PIDDUCK, Patrick** [CA/CA]; 267 Castlefield Avenue, Waterloo, Ontario N2K 2M4 (CA). **VON HATTEN, Philip** [CA/CA]; 2240 Walker Road, New Hamburg, Ontario N0B 2G0 (CA). **LEHAN, Tim** [CA/CA]; 168 Samual Street, Kitchener, Ontario N2H 1R1 (CA). **ONISCHKE, Mark** [CA/CA]; 220-150 Country Hills Drive, Kitchener, Ontario N2E 3H2 (CA). **GRASSICK, Clayton** [CA/CA]; 15 Cambrian Crescent, Winnipeg, Manitoba R3R 1Y3 (CA).

(74) Agents: **GRAHAM, Robert, J.** et al.; Gowling Lafleur Henderson LLP, Suite 4900, Commerce Court West, Toronto, Ontario M5L 1J3 (CA).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,

[Continued on next page]

(54) Title: SECURE NETWORK RESOURCE ACCESS SYSTEM



(57) Abstract: A secure network resource access system facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server, to receive application data and associated network resource data from the proxy server in response to the poll, and to direct the application data to one of the network resources in accordance with the associated network resource data.

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NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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International Application No
PCT/CA 01/00235

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 696 898 A (GROSSE ERIC ET AL) 9 December 1997 (1997-12-09) claim 1 ---	1-4
X	WO 98 40992 A (INTERNET DYNAMICS INC) 17 September 1998 (1998-09-17) page 2, line 24 -page 5, line 28 abstract -----	1-4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November 2001	20/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Veen, G

INTERNATIONAL SEARCH REPORT

Information on patent family members

rnational Application No
PCT/CA 01/00235

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 5696898 A	09-12-1997	CA	2196867 A1	07-12-1996
		CN	1159234 A	10-09-1997
		EP	0793826 A1	10-09-1997
		WO	9715008 A1	24-04-1997
WO 9840992 A	17-09-1998	US	6105027 A	15-08-2000
		US	6178505 B1	23-01-2001
		AU	733109 B2	10-05-2001
		AU	6452798 A	29-09-1998
		EP	0966822 A2	29-12-1999
		WO	9840992 A2	17-09-1998
		WO	0000879 A2	06-01-2000

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(51) International Patent Classification[7]: H04L 12/24, 29/06

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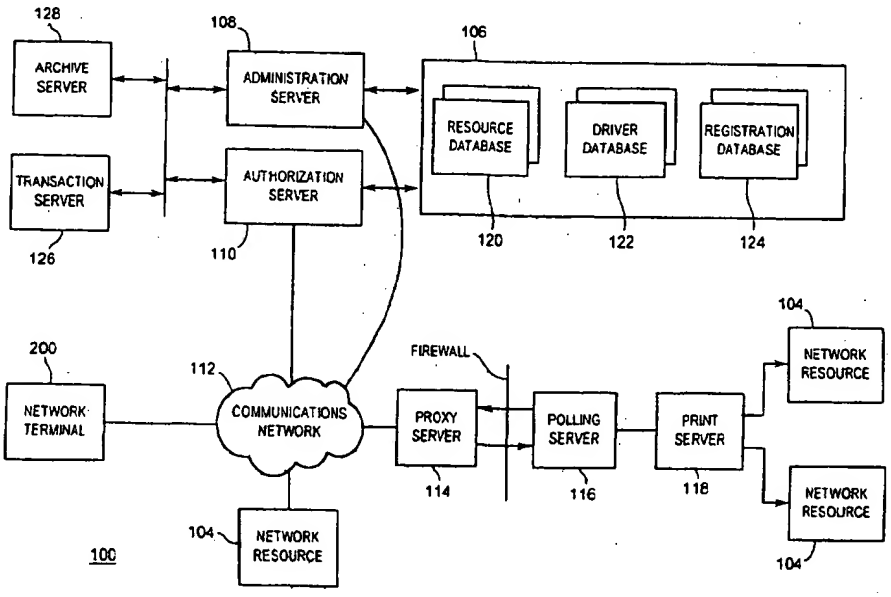
(74) Agents: **GRAHAM, Robert, J.** et al.; Gowling Lafleur Henderson LLP, Suite 4900, Commerce Court West, Toronto, Ontario M5L 1J3 (CA).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,

[Continued on next page]

(54) Title: SECURE NETWORK RESOURCE ACCESS SYSTEM



(57) Abstract: A secure network resource access system facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server, to receive application data and associated network resource data from the proxy server in response to the poll, and to direct the application data to one of the network resources in accordance with the associated network resource data.

WO 01/065768 A3

DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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SECURE NETWORK RESOURCE ACCESS SYSTEM

FIELD OF THE INVENTION

The present invention relates to a method and system for network management system. In particular, the present invention relates to a method and system for providing secure access to network resources.

BACKGROUND OF THE INVENTION

Local area networks are widely used as a mechanism for making available computer resources, such as file servers, scanners, and printers, to a multitude of computer users. It is often desirable with such networks to restrict user access to the computer resources in order to manage data traffic over the network and to prevent unauthorized use of the resources. Typically, resource access is restricted by defining access control lists for each network resource. However, as the control lists can only be defined by the network administrator, it is often difficult to manage data traffic at the resource level.

Wide area networks, such as the Internet, have evolved as a mechanism for providing distributed computer resources without regard to physical geography. Recently, the Internet Print Protocol ("IPP") has emerged as a mechanism to control access to printing resources over the Internet. However, IPP is replete with deficiencies.

First, as IPP-compliant printing devices are relatively rare, Internet printing is not readily available.

Second, although IPP allows user identification information to be transmitted to a target resource, access to IPP-compliant resources can only be changed on a per-resource basis. This limitation can be particularly troublesome if the administrator is required to change permissions for a large number of resources.

Third, users must have the correct resource driver and know the IPP address of the target resource before communicating with the resource. Therefore, if the device type or the IPP address of the target resource changes, users must update the resource driver and/or the IPP address of the resource. Also, if a user wishes to communicate

with a number of different resources, the user must install and update the resource driver and IPP address for each resource as the properties of each resource changes.

Fourth, access to IPP printers cannot be obtained without the resource administrator locating the resource outside the enterprise firewall, or without opening an access port through the enterprise firewall. Whereas the latter solution provides the resource administrator with the limited ability to restrict resource access, the necessity of opening an access port in the enterprise firewall exposes the enterprise network to the possibility of security breaches.

Consequently, there remains a need for a network resource access solution which allows resource owners to easily and quickly control resource access, which is not hindered by changes in device type and resource network address, which facilitates simultaneous communication with a number of target resources, and which does not expose the enterprise network to a significant possibility of security breaches.

SUMMARY OF THE INVENTION

According to the invention, there is provided a secure network resource access system and a method of secure network resource access which addresses at least one deficiency of the prior art network resource access systems.

The secure network resource access system, according to the present invention facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server.

The secure network resource access method, according to the present invention, facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises the steps of (1) polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources; (2) receiving application data and associated network resource

data from the proxy server in response to the polling step; and (3) directing the application data to one of the network resources in accordance with the associated network resource data.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the invention will now be described, by way of example only, with reference to the drawings, in which:

Fig. 1 is a schematic view of the network resource access system, according to the present invention, showing the network terminals, the network resources, the resource registry, the authorization server, the administration server, the proxy server, and the polling server;

Fig. 2 is a schematic view one of the network terminals depicted in Fig. 1, showing the driver application for use with the present invention;

Fig. 3 is a schematic view of the format of the resource records comprising the resource database of the resource registry depicted in Fig. 1, showing the network address field, the resource type field, the user access level field, the resource information field, the pseudo-name field, the username/password field, and the driver identification field; and

Fig. 4 is a flow chart depicting the method of operation of the network resource access system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to Fig. 1, a network resource access system, denoted generally as 100, is shown comprising a network terminal 200, a network resource 104, a resource registry 106, an administration server 108, and an authorization server 110. Typically, the network resource access system 100 comprises a plurality of network terminal 200, and a plurality of network resources 104, however for enhanced clarity of discussion, Fig. 1 only shows a single network terminal 200 and a single network resource 104.

The network resource access system 100 also includes a communications network 112 facilitating communication between the network terminals 200, the network resources 104, the administration server 108, and the authorization server 110. Preferably, the communications network 112 comprises a wide area network such as the Internet, however the network 112 may also comprise a local area network. Further, the network 112 need not be a land-based network, but instead may comprise a wireless network and/or a hybrid of a land-based network and a wireless network for enhanced communications flexibility.

Each network terminal 200 typically comprises a land-based network-enabled personal computer. However, the invention is not limited for use with personal computers. For instance, one or more of the network terminals 200 may comprise a wireless communications device, such as a wireless-enabled personal data assistant, or e-mail-enabled wireless telephone if the network 112 is configured to facilitate wireless data communication. In addition, the invention is not limited to only facilitating transmission of text data, but instead may be used to transmit image data, audio data or multimedia data, if desired.

As shown in Fig. 2, the network terminal 200 comprises a network interface 202, a user interface 204, and a data processing system 206 in communication with the network interface 202 and the user interface 204. Typically, the network interface 202 comprises an Ethernet network circuit card, however the network interface 202 may also comprise an RF antenna for wireless communication over the communications network 112. Preferably, the user interface 204 comprises a data entry device 208 (such as keyboard, microphone or writing tablet), and a display device 210 (such as a CRT or LCD display).

The data processing system 206 includes a central processing unit (CPU) 208, and a non-volatile memory storage device (DISC) 210 (such as a magnetic disc memory or electronic memory) and a read/write memory (RAM) 212 both in communication with the CPU 208. The DISC 210 includes data which, when loaded into the RAM 212, comprise processor instructions for the CPU 208 which define memory objects for allowing the network terminal 200 to communicate with the network resources 104 and the authorization server 110 over the communications network 112. The network

terminal 200, and the processor instructions for the CPU 208 will be discussed in greater detail below.

Typically, each network resource 104 comprises a printing device, and in particular, an IPP-compliant printer. However, the invention is not limited for use with networked printers (IPP-compliant or otherwise), but instead can be used to provide access to any of a variety of data communication devices, including facsimile machines, image servers and file servers. Further, the invention is not limited for use with land-based data communications devices, but instead can be used to provide access to wireless communications devices. For instance, the network resource access system 100 can be configured to facilitate data communication with e-mail pagers or e-mail enabled wireless telephones.

It is expected that some of the network resources 104 may be located behind an enterprise firewall. Accordingly, to facilitate communication between network terminals 200 and firewall-protected network resources 104, the network resource access system 100 may also include a proxy server 114 located logically outside the enterprise firewall, and a polling server 116 located logically within the firewall, as shown in Fig. 1. Preferably, the proxy server 114 is located on-site at the enterprise responsible for administering the network resource 104, is provided with a network address corresponding to the enterprise, and includes a queue for receiving application data. However, the proxy server 114 may also be located off-site, and may be integrated with the authorization server 110 if desired. This latter option is advantageous since it allows system administrators to provide access to network resources 104, but without having to incur the expense of the domain name registration and server infrastructure.

In addition to the proxy server 114 and the polling server 116, preferably the enterprise includes an enterprise server 118 (eg. a print server) to facilitate communication with the network resources 104 located behind the firewall. The polling server 116 is in communication with the enterprise server 118, and is configured to periodically poll the proxy server 114 through the firewall to determine whether application data from a network terminal 200 is waiting in the queue of the proxy server 114. The proxy server 114 is configured to transmit any queued

application data to the polling server 116 in response to the poll signal from the polling server 116. Upon receipt of the queued application data from the proxy server 114, the polling server 116 transmits the application to the enterprise server 118 for distribution to the appropriate network resource 104. As will be apparent, this mechanism allows application data to be transmitted to network resources 104 located behind a firewall, but without exposing the enterprise to the significant possibility of security breaches associated with firewall access ports.

The resource registry 106 comprises a resource database 120, a driver database 122, and a user registration database 124. The resource database 120 includes resource records 300 identifying parameters associated with the network resources 104. As shown in Fig. 3, each resource record 300 comprises a network address field 302, a resource type field 304, and a user access level field 306 for the associated network resource 104. The network address field 302 identifies the network address of the network resource 104. As discussed above, typically each network resource 104 comprises an IPP-compliant printer, in which case the network address field 302 identifies comprises the network resource IPP address. However, in the case where the network resource 104 comprises a non-IPP-compliant device and the communications network 112 comprises the Internet, preferably the network resource 104 is linked to the communications network 112 via a suitable server, and the network address field 302 for the network resource 104 identifies the Internet Protocol ("IP") address of the server.

The resource type field 304 identifies the type of data communication device of the network resource 104. For instance, the resource type field 304 may specify that the network resource 104 is a printer, an image server, a file server, an e-mail pager, or an e-mail enabled wireless telephone. Further, the resource type field 304 may include a resource type sub-field specifying a sub-class of the network resource type. For example, the resource type sub-field may specify that the network resource 104 is an IPP-capable printer, or a non-IPP-capable printer.

The user access level field 306 identifies the type of communications access which the network terminals 200 are allowed to have in regards to the associated network

resource 104. In the embodiment, as presently envisaged, the user access level field 306 establishes that the network resource 104 allows one of:

(a) "public access" in which any network terminal 200 of the network resource access system 100 can communicate with the network resource 104;

(b) "private access" in which only members (eg. employees) of the enterprise associated with the network resource 104 can communicate with the network resource 104; and

(c) "authorized access" in which only particular network terminals 200 can communicate with the network resource 104.

If the user access level field 306 specifies "authorized access" for a network resource 104, preferably the user access level field 306 includes a sub-field which lists the names of the network terminals 200 authorized to access the network resource 104, and a sub-field which includes an authorization password which the identified network terminals 200 must provide in order to access the network resource 104. If the user access level field 306 specifies "private access" for a network resource 104, preferably the user access level field 306 includes a sub-field which lists the network address of the network terminals 200 which are deemed to members of the enterprise.

It should be understood, however, that the user access level field 306 is not limited to identifying only the foregoing predefined user access levels, but may instead identify more than one of the predefined user access levels, or other user access levels altogether. For instance, the user access level field 306 may identify that the associated network resource 104 allows both private access to all employees of the enterprise running the network resource 104, and authorized access to other pre-identified network terminals 200. Further, the user access level field 306 may also include one or more sub-fields (not shown) which provide additional restrictions/permissions on the type of communications access which the network terminals 200 are allowed to have in regards to the associated network resource 104. For instance, the user access level sub-fields may limit the hours of operation of the network resource 104, or may place restrictions on the type of access limitations on a per-user basis, or per-group basis. Other variations on the type of access will be

readily apparent, and are intended to be encompassed by the scope of the present invention.

Preferably, each resource record 300 includes an information field 308 which provides information on the network resource 104, such as data handling capabilities, resource pricing and geographical co-ordinates. This latter parameter is particularly advantageous for use with mobile network terminals 200, such as a wireless-enabled personal data assistant or an e-mail-enabled wireless telephone, since it allows the network terminal 200 to identify the nearest one of a plurality of available network resources 104. This aspect of the invention will be explained in greater detail below.

Each resource record 300 also includes a pseudo-name field 310, a username/password field 312 and a network driver identifier field 314. The pseudo-name field 310 contains a resource pseudo-name which identifies the network resource 104 to the network terminals 200. Preferably, the pseudo-name is a network alias that identifies the physical location and properties of the network resource 104, but does not identify the network address of the resource 104. Further, preferably each pseudo-name uniquely identifies one of the network resources 104, however a group of the network resources 104 may be defined with a common pseudo-name to allow communication with a group of network resources 104. This latter feature is particularly advantageous since it allows the administrator of an enterprise associated with the group of network resources to dynamically allocate each network resource 104 of the group as the demands for the network resources 104 or maintenance schedules require.

In addition, preferably the resource record 300 includes a plurality of the pseudo-name fields 310 to allow the administrator of the associated network resource 104 to update the name assigned to the network resource 104, while also retaining one or more previous pseudo-names assigned to the network resource 104. As will be explained, this feature is advantageous since it allows the administrator to update a resource name without the risk that network terminals 200 using a prior pseudo-name will be unable to locate or communicate with the network resource 104.

The username/password field 312 contains a unique username and password combination which allows the administrator of the associated network resource 104 to prevent authorized access and alteration to the data contained in the resource record 300. Preferably, each resource record 300 also includes an e-mail address field (not shown) which the network resource access system 100 uses to provide the administrator of the associated network resource 104 with a notification e-mail message when a message is successfully transmitted to the network resource 104.

The driver identifier field 314 contains a resource driver identifier which is used in conjunction with the driver database 122 to provide the network terminals 200 with the appropriate resource driver for communication with the network resource 104. The driver database 122 includes resource drivers which allow software applications installed on the network terminals 200 to communicate with the network resources 104. As will be explained below, in order for a network terminal 200 to communicate with a selected network resource 104, the network terminal 200 first downloads a driver application data from the administration server 108 over the communications network 112. The network terminal 200 may also download the appropriate resource driver from the driver database 122 (via the authorization server 110 over the communications network 112), and then allow the authorization server 110 to configure the downloaded resource driver in accordance with the access level field 306 of the resource record 300 associated with the selected network resource 104. Preferably, each resource driver includes a resource driver identifier which allows the authorization server 110 to identify the resource driver which the network terminal 200 has downloaded.

The driver application will now be discussed in association with Fig. 2. As discussed above, the DISC 210 of the network terminal 200 includes data which, when loaded into the RAM 212 of the network terminal 200, comprise processor instructions for the CPU 208. As shown, the downloaded driver application data defines in the RAM 212 a memory object comprising a driver application 400. The driver application 400 includes a generic resource driver 402 and a wrap-around resource driver layer 404. The generic resource driver 402 allows the network terminal 200 to communicate with a variety of different network resources 104, however the generic resource driver 402 typically will not provide the network terminal 200 with access to all the features and

capabilities of any particular network resource 104. If the network terminal 200 requires additional features not implemented with the generic resource driver 402, the appropriate resource driver may be downloaded from the driver database 116, as mentioned above.

The wrap-around driver layer 404 includes an application communication layer 406, a driver administrator layer 408, and a data transmitter layer 410. The application communication layer 406 is in communication with the resource driver 402 (generic or network resource specific) and the application software installed on the network terminal 200, and is configured to transmit user application data between the application software and the resource driver 402. The driver administrator layer 408 communicates with the resource registry 106 over the communications network 112 to ensure that the driver application 400 is properly configured for communication with the selected network resource 104. The data transmitter layer 410 is in communication with the resource driver 402 and is configured to transmit the data output from the resource driver 402 over the communications network 112 to the selected network resource 104, via the network interface 202. Although the driver application 400 and its constituent component layers are preferably implemented as memory objects or a memory module in the RAM 212, it will be apparent that the driver application 400 may instead be implemented in electronic hardware, if desired.

Returning to Fig. 1, the registration database 124 of the resource registry 106 includes user records each uniquely associated with a user of a respective network terminal 200 upon registration with the network resource access system 100. Each user record identifies the name the registered user's name, post office address and e-mail address. In addition, each user record specifies a unique password which the registered user must specify in order to update the user's user record, and to obtain access to network resources 104 configured for "authorized access". The user record may also include additional information specifying default options for the network resource access system 100. For instance, the user may specify that the network resource access system 100 should provide the user with an acknowledgement e-mail message when a message is successfully transmitted to a selected network resource 104. The user may also specify an archive period for which the network resource access system 100 should archive the message transmitted to the selected network resource 104. This

latter option is advantageous since it allows the user to easily transmit the same message to multiple network resources 104 at different times, and to periodically review transmission dates and times for each archive message.

The administration server 108 is in communication with the resource database 120 and the registration database 124. The administration server 108 provides administrators of the network resources 104 with access to the records of the resource database 120 to allow the administrators to update the network address field 302, the resource type field 304, the user access level field 306, the resource information field 308, the pseudo-name field 310, the username/password field 312 and/or the driver identifier field 314 of the resource record 300 for the associated network resource 104. As will become apparent, this mechanism allows network administrators to change, for example, the network address and/or the restrictions/permissions of the network resources 104 under their control, or even the network resource 104 itself, without having to notify each network terminal 200 of the change. The administration server 108 also provides controlled access to the registration database 124 so that only the user of the network terminal 200 which established the user record can update the user record.

Where the username/password field 312 has been completed, the administration server 108 is configured to block access to the resource record 300 until the administrator provides the administration server 108 with the correct username/password key. This feature allows the resource administrator to make adjustments, for example, to pricing and page limit, in response to demand for the network resources 104, and to make adjustments to the restrictions/permissions set out in the user access level field 306 and the resource information field 308 and thereby thwart unauthorized access to the network resources 104.

The authorization server 110 is in communication with the resource database 120 and the driver database 122 for providing the network terminals 200 with the resource drivers 402 appropriate for the selected network resources 104. Preferably, the authorization server 110 is also configured to configure the driver application 400 for communication with the selected network resource 104, by transmitting the network address of the selected network resource 110 to the data transmitter layer 410 over a

communications channel secure from the user of the network terminal 200 so that the network address of the network resource 104 is concealed from the user of the network terminal 200. In the case where the communications network 112 comprises the Internet, preferably the secure communications channel is established using the Secure Sockets Layer ("SSL") protocol.

In addition to the network terminal 200, the network resource 104, the resource registry 106, the administration server 108, the authorization server 110, and the communications network 112, preferably the network resource access system 100 also includes a transaction server 126 and an archive server 128. The transaction server 126 is in communication with the authorization server 110 for keeping track of each data transfer between a network terminal 200 and a network resource 104. For each transmission, preferably the transaction server 126 maintains a transmission record identifying the network terminal 200 which originated the transmission, the network resource 104 which received the transmission, and the date, time and byte size of the transmission.

The archive server 128 is configured to retain copies of the data transmitted, for a specified period. As discussed above, the user of a network terminal 200 specifies the requisite archive period (if any) for the data transmission, upon registration with the network resource access system 100. Preferably, the administration server 108 provides controlled access to the transaction server 126 and the archive server 128 so that only the user of the network terminal 200 which originated transmission of the data is allowed access to the transmission record associated with the transmission.

The process by which a user of a network terminal 200 can communicate with a network resource 104 will now described with reference to Fig. 4. The following discussion presupposes that the user of the network terminal 200 has downloaded the driver application 400 from the administration server 108 over the communications network 112. At step 500, the user of a network terminal 200 decides whether to log in to the network resource access system 100. As discussed above, if the user registers with the network resource access system 100 and subsequently logs in to the network resource access system 100 (by providing the authorization server 106 with the user's assigned password), the user will have access to any network resources 104

which have "authorized access" as the user access level and which have identified the registered user as a user authorized to access the network resource 104. If the user does not register or fails to log in to the network resource access system 100, the user will only have access to network resources 104 which have established "public access" as the user access level.

At step 502, the user selects a network resource 104 by querying the administration server 108 for a list of available network resources 104. Alternately, the user may postpone selection of a network resource 104 until initiation of the transmission command. The network user query may be based upon any desired criteria, including print turn-around time and page size (where the target network resource 104 is a printer), price, and geography. In addition, the user may provide the administration server 108 with the geographical coordinates of the user to determine the user's nearest network resources. The user may provide its geographical coordinates through any suitable mechanism known to those skilled in the art, including latitude/longitude co-ordinates, GPS, and wireless triangulation.

If the user requested a list of available network resources 104, the user is provided with a list of pseudo-names associated with each network resource 104 satisfying the designated search criteria. As discussed above, if the user logged in to the network resource access system 100, the pseudo-name list will include both "public access" network resources 104 and "authorized access" network resources 104 with which the user has been authorized to communicate. Also, if the user is member of an enterprise having network resources 104 registered with the network resource access system 100, the pseudo-name list will also identify network resources 104 which have been registered by the enterprise for "private access". Otherwise, the pseudo-name list will only identify network resources 104 registered for public access. Upon receipt of the resource list, the user selects a network resource 104 from the list.

At step 504, the administration server 108 queries the network user's network terminal 200 for the resource driver identifier of the resource driver 402 configured on the network terminal 200, and then compares the retrieved resource driver identifier against the resource driver identifier specified in the network driver identifier field 314 of the resource record 300 associated with the selected network resource 104 to

determine whether the driver application 400 has been configured with the appropriate resource driver 402 for communication with the network resource 104. If the network terminal 200 has not been configured with the appropriate resource driver 402, the administration server 108 prompts the user's network terminal 200 to download the necessary resource driver 402. As will be apparent, the downloaded resource driver 402 becomes part of the driver application 400.

When the user of the network terminal 200 is ready to communicate with the selected network resource 104, the user of the network terminal 200 transmits a transmission request via its application software to the driver application 400, at step 506. If the user did not select a network resource 104 at step 502, the application communication layer 406 of the driver application 400 contacts the administration server 108 over the communications network 112 and prompts the user to select a network resource 104, as described above. Once a network resource 104 is selected, and the appropriate resource driver 402 is installed, the application communication layer 406 notifies the driver administrator layer 408 of the transmission request.

At step 508, the driver administrator layer 408 provides the authorization server 110 with the transmission request and identifies the selected network resource 104, by transmitting to the authorization server 110 the pseudo-name assigned to the selected network resource 104. If the user of the network terminal 200 has registered and logged in to the network resource access system 100, the driver administrator layer 408 also provides the authorization server 110 with the registered user's name.

The authorization server 110 then queries the resource database 120 with the received pseudo-name for the resource record 300 associated with the pseudo-name, at step 510. The authorization server 110 then extracts the user access level from the user access level field 306 of the retrieved resource record 300, and determines whether the network terminal 200 is authorized to communicate with the selected network resource104, at step 512. As will be apparent from the foregoing discussion, if the user access level field 306 specifies "public access" for the network resource 104, the network terminal 200 will be automatically authorized to communicate with the network resource 104.

However, if the user access level field 306 specifies "private access" for the network resource 104, the authorization server 110 determines the network address of the network terminal 200 from the transmission request transmitted by the network terminal 200, and then queries the user access level sub-field with the terminal's network address to determine whether the network terminal 200 is authorized to communicate with the network resource104. In the case where the communications network 112 comprises the Internet, the authorization server 110 can determine the network terminal's network address from the IP packets received from the network terminal 200. On the other hand, if the user access level field 306 specifies "authorized access" for the network resource 104, the authorization server 110 queries the user access level sub-field with the user's name to determine whether the network terminal 200 is authorized to communicate with the network resource104.

If the query at step 512 reveals that the network terminal 200 is not authorized to communicate with the network resource104, at step 514 the authorization server 110 provides the network terminal 200 with a notification that the network terminal 200 is not authorized for communication with the selected resource 104. However, if the query at step 512 reveals that the network terminal 200 is authorized to communicate with the network resource 104, the authorization server 110 queries the network address field 302 of the resource record 300 associated with the network resource 104 for the network address of the network resource 104. The authorization server 110 then establishes a secure communications channel with the driver administrator layer 408, and then transmits the network address to the driver administrator layer 408 over the secure communications channel, at step 516.

Also, if the user access level field 306 specifies "authorized access" for the network resource 104, and the network terminal 200 is authorized to communicate with the network resource104, the authorization server 110 queries the user access level sub-field for the authorization password assigned to the network resource 104, and then transmits the authorization password to the driver administrator layer 408 over the secure communications channel, together with the network address. In the case where the communications network 112 comprises the Internet, preferably the authorization server 110 establishes the secure communications channel using a Secure Sockets Layer ("SSL") protocol. Since the network address and the authorization password

are transmitted over a secure communications channel, this information is concealed from the user of the network terminal 200.

Preferably, the authorization server 110 also extracts the resource driver identifier from the resource identifier field 314 of the resource record 300, and determines whether the network terminal 200 is still properly configured for communication with the network resource 14. If the network terminal 200 no longer has the correct resource driver 402, the authorization server 110 queries the driver database 122 for the correct resource driver 402, and prompts the user of the network terminal 200 to download the correct resource driver 402. This driver configuration verification step may be performed concurrently or consecutively with the network address providing step described in the preceding paragraph.

In addition, the administration server 108 queries the registration database 124 to determine whether the user of the network terminal 200 registered with the network resource access system 100. If the user registered with the network resource access system 100 and specified that the archive server 128 should maintain archival copies of data transmissions, the administration server 108 transmits the network address of the archive server 128 to the driver administrator layer 408. As a result, when the user of the network terminal 200 issues a data transmission command, the driver application 400 will transmit the user application data to the selected network resource 104 and to the archive server 128.

At step 518, the application communication layer 406 passes the application data received from the application software to the resource driver 402 for translation into a format suitable for processing by the selected network resource 104. Meanwhile, the driver administrator layer 408 interrogates the network resource 104, using the received network address, to determine whether the network resource 104 still resides at the specified network address, is operational and is on-line.

If the interrogated network resource 104 resides at the specified network address, is operational and is on-line. online, the resource driver 202 passes the translated application data to the data transmitter layer 410 of the driver application 400. Preferably, the data transmitter layer 410 compresses and encrypts the translated

application data upon receipt. The data transmitter layer 410 also receives the network address of the network resource 104 from the driver administrator layer 408, adds the network address data to the compressed, encrypted data, and then transmits the resulting data over the communications network 112 to the network resource 104 at the specified network address, at step 520.

Preferably, the data transmitter layer 410 also transmits details of the transmission to the transaction server 126, such as the selected network resource 104 and the byte size of the transmission. Upon receipt of the transmission details, preferably the administration server 108 queries the resource database 120 and the user registration database 124 for the e-mail address of the resource administrator and the e-mail address of the user of the network terminal 200, if provided, and then transmits an e-mail message indicating completion of the transmission.

If the user access level field 306 specifies "authorized access" for the network resource 104, the data transmitter layer 410 also receives the authorization password for the network resource 104 from the driver administrator layer 408, and transmits the authorization password (as part of the compressed, encrypted data) to the network resource 104.

If the user access level field 306 specifies "public access" for the network resource 104, preferably the network resource 104 is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data, and then transmit the decompressed application data to the appropriate network resource 104. Alternately, the network resource 104 itself may be configured for direct communication over the communications network 112, such as an IPP-capable printer, so that the network resource 104 is able to process the application data directly.

If the user access level field 306 specifies "authorized access" for the network resource 104, preferably the network resource 104 is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data and authorization password, and then transmit the application

data to the appropriate network resource 104 if the received authorization password is valid.

If the user access level field 306 specifies "private access" for the network resource 104, typically the network resource 104 will be located behind a firewall. Accordingly, the proxy server 114 associated with the network resource 104 will receive the application data, and transfer the application data to the proxy server queue. The polling server 116 associated with the network resource 104 will poll the proxy server 114 to determine the status of the queue. Upon receipt of a polling signal from the polling server 116, the proxy server 114 transmits any queued application data from the proxy server queue, through the firewall, to the polling server 116. The polling server 116 then extracts the network address from the received application data, and transmits the application data to the appropriate server 118 or network resource 104 for processing.

As will be apparent from the foregoing discussion, regardless of the user class defined for a network resource 104, if a resource administrator relocates a network resource 104 to another network address, and/or changes the device type and/or restrictions/permissions associated with the network resource 104, the resource administrator need only update the resource record 300 associated with the network resource 104 to continue communication with the network resource 104. Subsequently, when a user attempts communication with the network resource 104 using the original pseudo-name, the authorization server 110 will provide the administrator layer 408 with the updated network address of the network resource 104, or prompt the user to download the appropriate resource driver 402, assuming that the network terminal 200 is still authorized to communicate with the network resource 104.

Further, if the user access level field 306 specifies "authorized access" for the network resource 104 and the resource administrator desires to change the pseudo-name and authorization password associated with the network resource 104, the resource administrator need only update the pseudo-name and authorization password provided on the resource record 300. Subsequently, when a user of a network terminal 200 initiates communication with the network resource 104 using the original pseudo-

name, the authorization server 110 scans the resource records 300 for occurrences of the original pseudo-name. After locating the appropriate resource record 300, the authorization server 110 provides the driver administrator layer 408 with the updated pseudo-name and authorization password of the network resource 104, provided that the network terminal 200 is still authorized to communicate with the network resource 104. A network terminal 200 which is not authorized to communicate with the network resource 104 will not receive the updated pseudo-name and authorization password from the authorization server 110 and, consequently, will not be able to communicate with the network resource 104, even if the user of the network terminal 200 knew the network address for the network resource 104.

The foregoing description is intended to be illustrative of the preferred embodiment of the present invention. Those of ordinary skill may envisage certain additions, deletions and/or modifications to the described embodiment which, although not explicitly described herein, are encompassed by the spirit or scope of the invention, as defined by the claims appended hereto.

WE CLAIM:

1. A secure network resource access system for facilitating network access by network terminals to network resources located behind an enterprise firewall, the secure network resource access system comprising:

a proxy server located logically outside the enterprise firewall for receiving application data from the network terminals; and

a polling server located logically behind the enterprise firewall, the polling server being configured for polling the proxy server to initiate transmission of the received application data from the proxy server to the polling server.

2. The secure network resource access system according to claim 1, wherein each said network resource includes an alias name, and the application data includes the alias name of one of the network resources, and the polling server is configured to direct the application data to the one network resource in accordance with alias name.

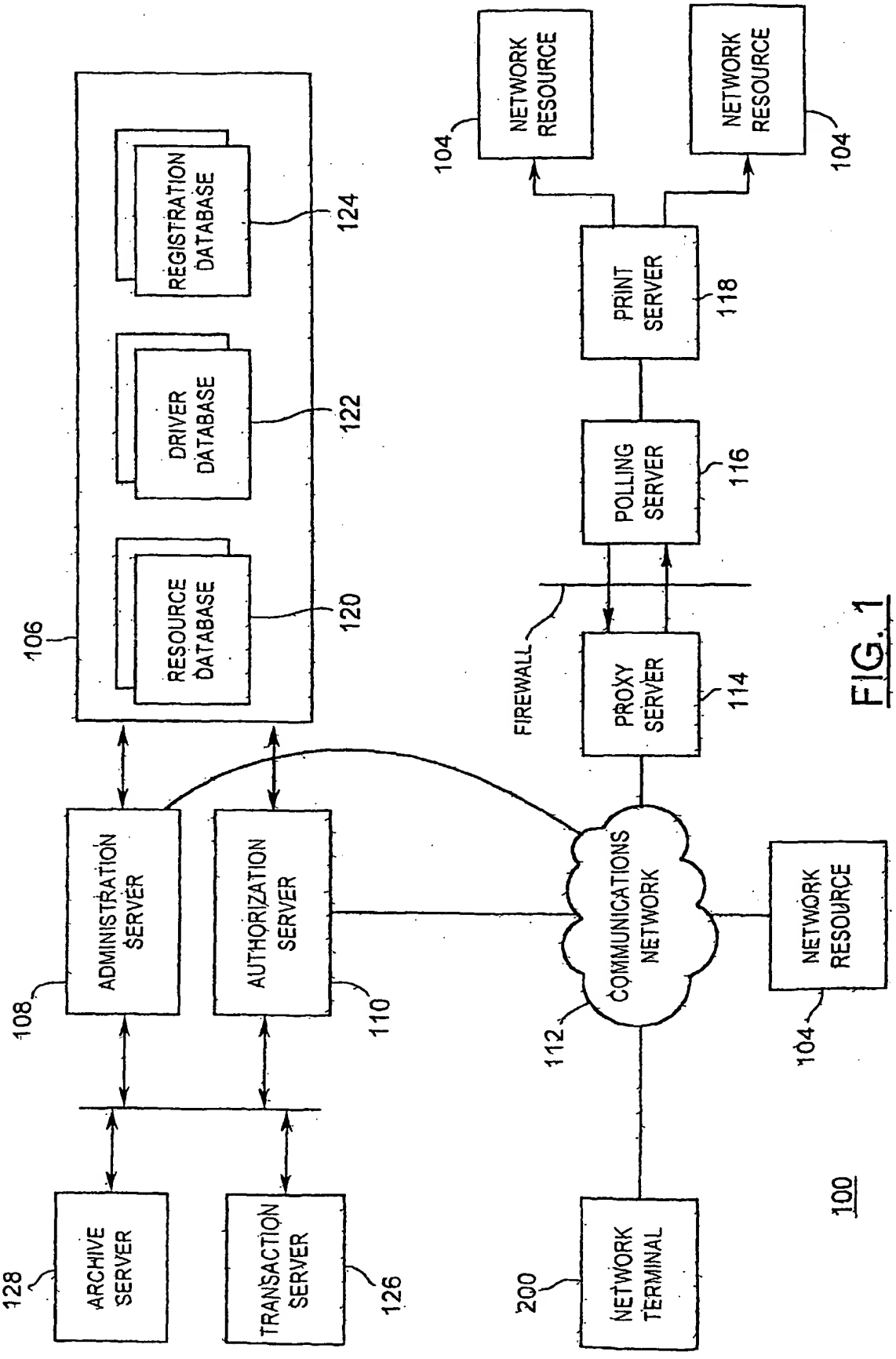
3. A method for facilitating secure network access by network terminals to network resources located behind an enterprise firewall, the method comprising the steps of:

polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources;

receiving application data and associated network resource data from the proxy server in response to the polling step; and

directing the application data to one of the network resources in accordance with the associated network resource data.

4. The method according to claim 3, wherein each said network resource includes an alias name, and the network resource data includes the alias name of the one network resource.


NETWORK RESOURCE
104
NETWORK RESOURCE
104
PRINT SERVER
118
POLLING SERVER
116
FIREWALL
PROXY SERVER
114
REGISTRATION DATABASE
124
DRIVER DATABASE
122
RESOURCE DATABASE
120
106
ADMINISTRATION SERVER
108
AUTHORIZATION SERVER
110
COMMUNICATIONS NETWORK
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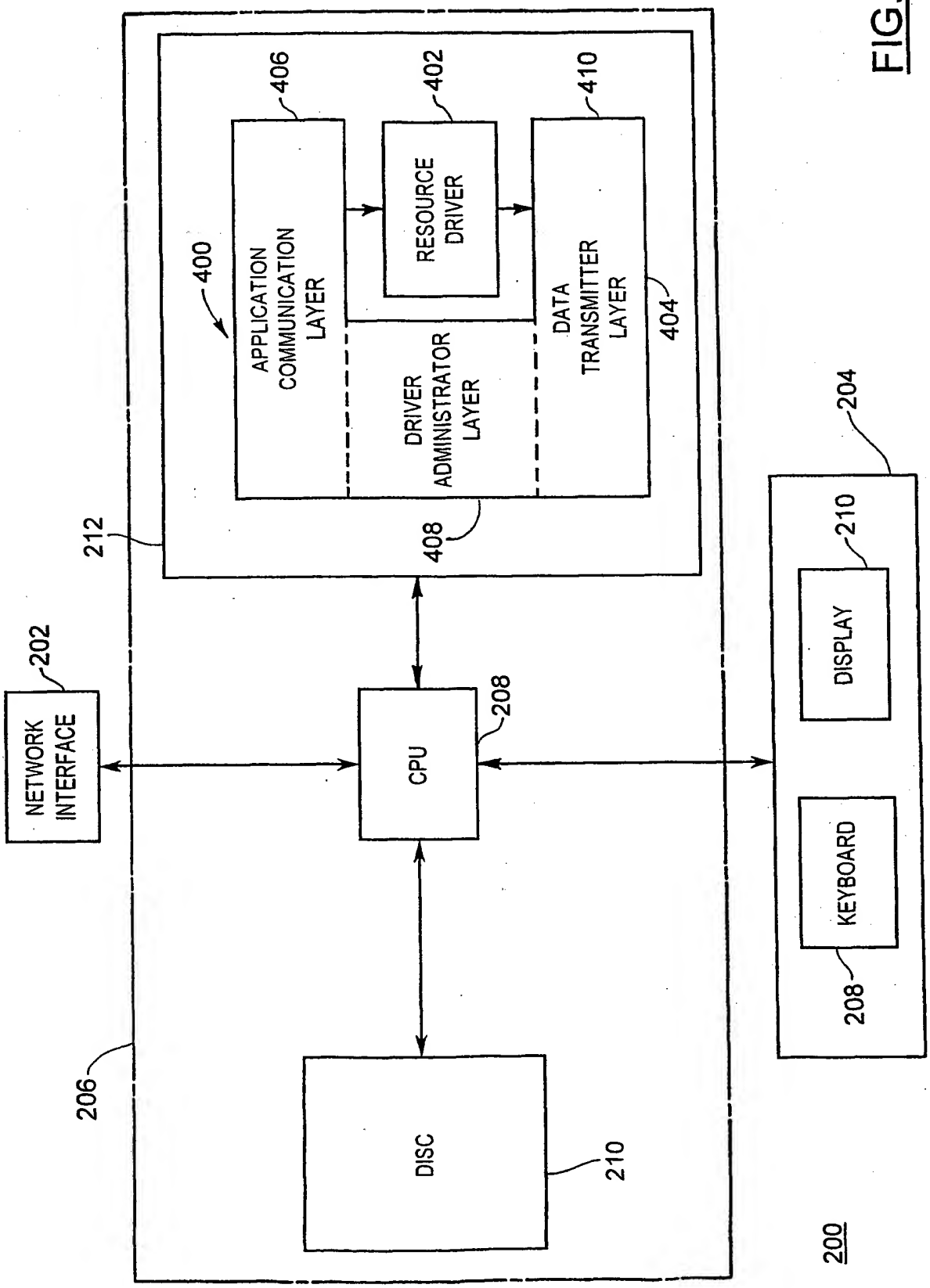
NETWORK RESOURCE
104
ARCHIVE SERVER
128
TRANSACTION SERVER
126
NETWORK TERMINAL
200
100

FIG. 1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206
212
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APPLICATION COMMUNICATION LAYER
406
RESOURCE DRIVER
402
DATA TRANSMITTER LAYER
410
404
DRIVER ADMINISTRATOR LAYER
408
NETWORK INTERFACE
202
CPU
208
DISC
210
204
DISPLAY
210
KEYBOARD
208

FIG. 2

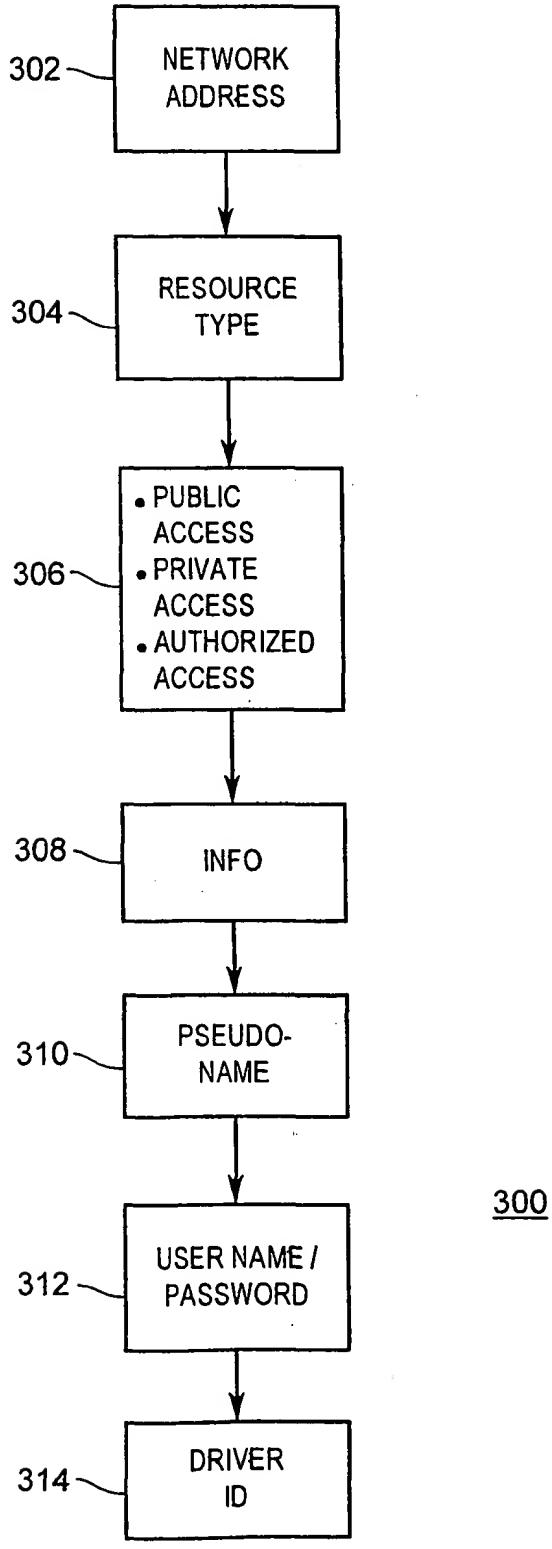
302
NETWORK ADDRESS
304
RESOURCE TYPE
306
• PUBLIC ACCESS
• PRIVATE ACCESS
• AUTHORIZED ACCESS
308
INFO
310
PSEUDO-NAME
312
USER NAME / PASSWORD
314
DRIVER ID
300

FIG. 3

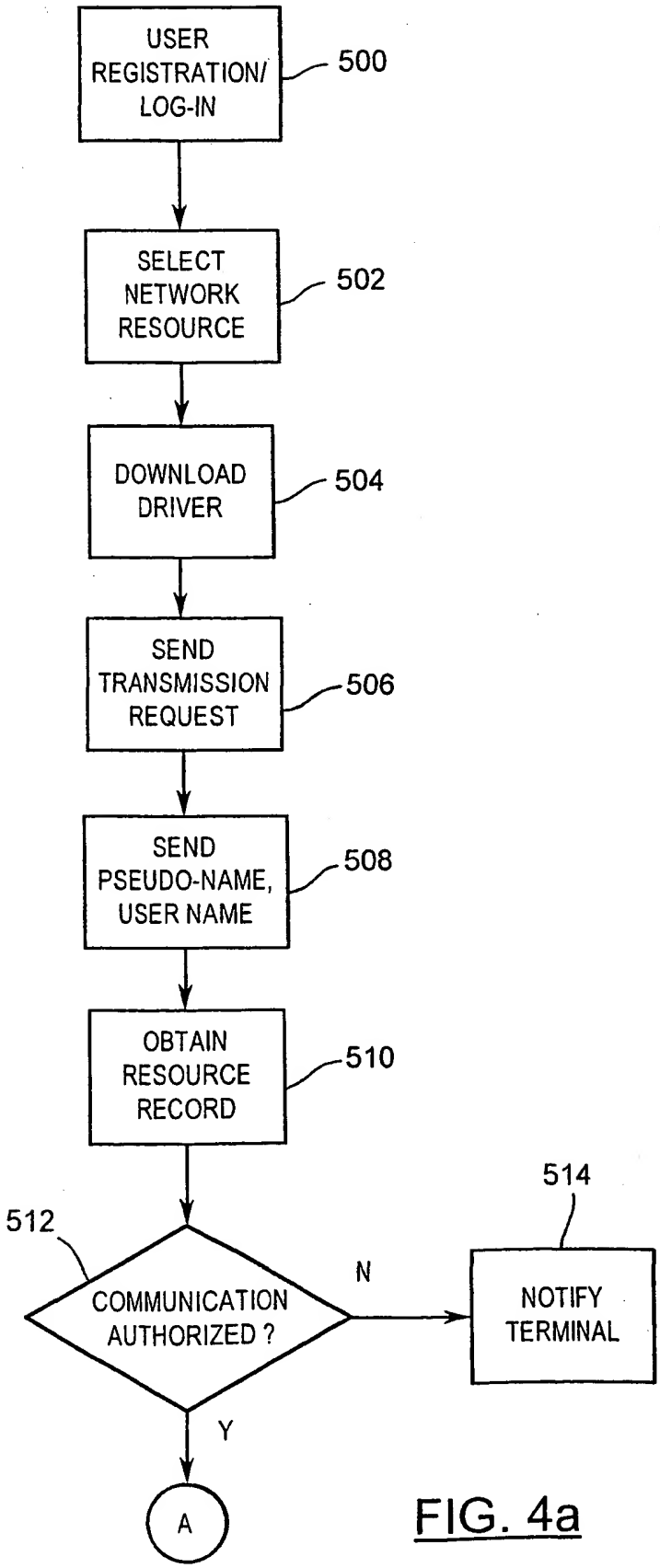
USER REGISTRATION/ LOG-IN
500
SELECT NETWORK RESOURCE
502
DOWNLOAD DRIVER
504
SEND TRANSMISSION REQUEST
506
SEND PSEUDO-NAME, USER NAME
508
OBTAIN RESOURCE RECORD
510
512
COMMUNICATION AUTHORIZED ?
N
514
NOTIFY TERMINAL
Y
A

FIG. 4a

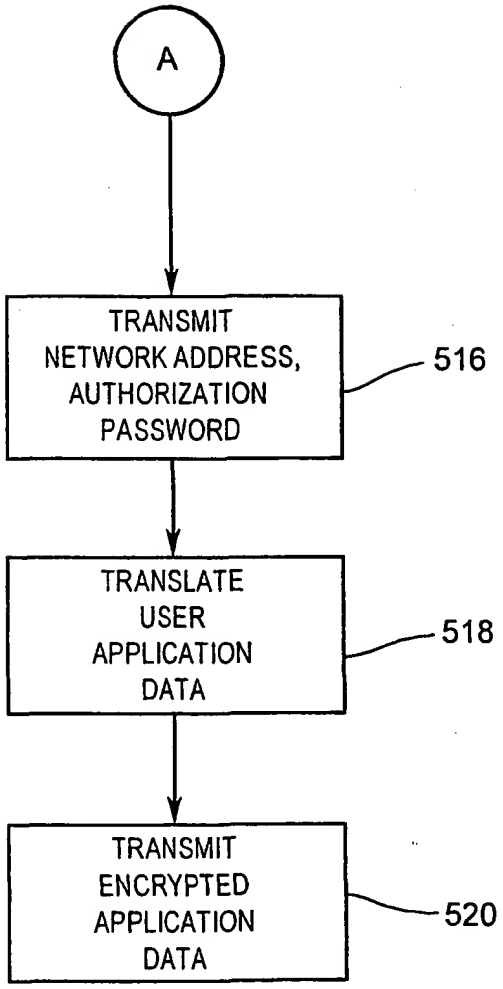
A
TRANSMIT NETWORK ADDRESS, AUTHORIZATION PASSWORD
516
TRANSLATE USER APPLICATION DATA
518
TRANSMIT ENCRYPTED APPLICATION DATA
520

FIG. 4b

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 01/00235

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/24 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 696 898 A (GROSSE ERIC ET AL) 9 December 1997 (1997-12-09) claim 1	1-4
X	WO 98 40992 A (INTERNET DYNAMICS INC) 17 September 1998 (1998-09-17) page 2, line 24 -page 5, line 28 abstract	1-4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
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